Egypt. Acad. J. Biolog. Sci., 5(2): 31-37 (2012) **A. Entomology**
Email: egyptianacademic@yahoo.com **ISSN: 1687–8809**
Received: 15/5/2012 **www.eajbs.eg.net**

The effect of parental traits on the son reproductive performance in high temperature condition

***Abolhasan Rezaei**
*Department of Genetics-School of Basic Science, Tonekabon Branch, Islamic Azad University, Tonekabon, Iran
Mailing Address: Islamic Azad University Tonekabon Branch-Iran. P.O. Box 4864161187, Tonekabon, Iran.
a.rezaei@tonekaboniau.ac.ir

ABSTRACT

This study is an investigation of three different ages, 2-3 days aged old (young), 27-28 days aged old (middle) and 52-53 days aged old (high) in male to test influence of aging and temperature on male reproductive performance, female fitness traits and also offspring fitness traits. The male reproductive performance including male mating ability and mating success on the female fitness traits, that were examined patterns of age dependence on the temperature behavior when exposed to high (29°c) temperature. At 29°c, between three ages (young, middle and old) the among of female fecundity and fertility was significantly reduced, compared to normal temperature. There was a significant egg laid and egg hatchability between young, middle and old age females (young>middle>old), also, in females that mated with son flies obtained from male young, middle and old aged, the variation of fecundity and fertility between females was significant, but the among of females fecundity and fertility that were mated with son's of male middle age was higher than young and old age: (middle>young> old).

Keywords: Parental traits, reproductive performance, *Drosophila melanogaster*, temperature

INTRODUCTION

The parental traits in male including, male age difference, male reproductive performance, male accessory glands elements, and sperm counting, while female including, female age difference, female reproductive performance, fecundity and fertility elements. In male *drosophila melanogaster*, an extreme study has discussed effect of aging on the reproductive performance. (Luckinbill *et al*. 1984; Rose 1984; Partridge and Fowler 1992; Zwaan *et al*. 1995; Partridge and Barton, 1996). High temperature condition is one of most important environmental factor on the reproductive performance such as viability and reproductive success. (David, Allemand, Herrewege and Cohet, 1983).

To continue of heat stress can progress from a decline in egg laid, egg hatchability and also increased mortality (Feder & Krebs, 1997; Fasolo & Krebs, 2004). Moreover, there is some evidence that high temperature is cause of variation on the populations being from different genetic backgrounds (Parsons, 1973). Surely, temperature can have effect on the mating success in male and female when compared with the other fitness components (Fulker, 1966; Prout, 1971; Parsons, 1973). Furthermore, male age effect is important on the male mating success and among of fecundity and fertility in females in wild *Drosophila melanogaster* (Anderson *et al*., 1979; Brittnacher, 1981). Fecundity and fertility as a fitness component can be affected by the presence of males (Serradilla and Ayala, 1983). Hansen and Price

1995; Brooks and Kemp 2001, proposed that age is often regarded as an important factor for mate choice. The aging cause of decreasing viability and fertility (qualification and quantification of accessory gland secretion or amount of sperm) might be contributed to a negative relationship between age and mate quality. In male of *Drosophila* species usually the amount of secretion evolved in 7 days and after this day, the secretion of accessory gland will be reduced (Ravi Ram and Ramesh, 2007). The reduction of secretion will be affected on the fecundity and fertility in females. In this study we aimed at discussing male age on the female fecundity and fertility, also influence of the parental age on the son fitness traits components.

MATERIALS AND METHODS

***Drosophila melanogaster* stocks:**

The flies were obtained from the National *Drosophila* Stock Centre, Department of Zoology (UOM)-India. These flies were used for studies of parental traits on the son reproductive performance in high temperature condition. The flies were cultured using wheat cream agar medium at 70% humidity and were exposed to high (29°c) temperature. Twenty flies quarter milk bottle (250ml) were maintained using 12:12 hour light /dark cycle. These flies were kept in vial by separating male and female and aged as required for next experiment.

Influence of high temperature on the paternal reproductive system and son fitness traits:

In the present study, we have used the effect of high temperature on parental and son fitness traits, such as fecundity and fertility elements. All of flies used in the fecundity and fertility assays were measured in temperatures of 29°c, this temperature was high. Fecundity including the among of egg laid in every day. Following the experiments, we collected parents everyone was week from grand parental groups and also offspring flies. For each three hours we collected 100 virgin males and 100 virgin females separated in vial until for mating them. The virgin males of each age including; 2-3(young age) , 27-28(middle age) and 52-53 (old age) days aged old with 5-6 days aged old females and also male and female offspring. In related to, males young aged after mated with female were kept in the wheat cream medium bottle(250 ml) for 27-28 days, soon mated with male middle aged and again kept in the wheat cream medium bottle (250 ml) for 52-53 days, soon mated with old male aged and kept for longitudinal studies. For getting records of egg laid, every replication we crossed one male and one female in wheat cream medium bottle (250 ml). Every 24 hours we counted egg laid under vials in fifty replicate and recorded. In most cases, usually maximum egg laid around first one to two weeks and almost for one month egg laid of females will be finished. However offspring period of egg laid was less.

The fertility elements in parental and offspring flies:

The fertility elements includes; among of hatchability of eggs in flies when exposed to high temperature. Regarding offspring also every three hours sons and daughters were counted and recorded. The sons flies were accessed from male 2-3 days aged old with female 5-6 days aged old, then these males were kept in the culture media vials until 27-28 days aged old, again these male mated with female 5-6 days aged old , then finally, permitted mated after 52-53 days aged old with virgin female. The sons flies (7 days aged old) from per three male ages (young, middle and old) were mated with female 5-6 days aged old, egg laid and egg hatchability were counted and recorded. Females also were used for studies of female components such as fecundity and fertility experiments. In males, in fact we got recording from one group males in three times. Every day flies were changed to new medium vial contain quarter pint milk culture (250 ml). Chambers with dead or injured females were removed.

The statistical programs:

The present study used SPSS software (version 10.1), for analysis of a pair t-test variation and also mean value of recorded. The information of male reproductive performance and also female fitness traits was planned followed from one temperature (high) and three ages (young, middle and old). This information was analysed by pair t-test with the average number of eggs and also offspring per female in the fifty trials as dependent to variable ages on the fecundity and fertility as dependent variable.

RESULTS

Influence of high temperature on the three age classes experiments:

The temperature was important for function of male-female and also offspring fitness in *Drosophila melanogaster*. In this study, we used unmated males including, young (2-3 days age old), middle (27-28 days age old) and old aged (52-53 days age old) when exposed to the high temperature. This temperature was highly stressful. The results were analysed by pair of T-test (SPSS software, ver.10.1), and also mean value of parameters. (Table 1), females of flies that mated with young aged male with exposure of high temperature, the among of egg laid was more than females that mated with middle and old male aged.

Table 1: The results of mean value of among female egg laid (fecundity) and female egg hatchability (fertility) in parental and also female egg laid (fecundity) and female egg hatchability (fertility) in female that mated with son flies. The results are shown between three age classes (young, middle and old) in parental and female mated with son, the among of egg laid and egg hatchability were different.

Fecundity, fertility, son fecundity, son fertility * Temperature and age					
Temperature		fecundity	fertility	Son fecundity	Son fertility
1.00	Mean	115.0000	53.9600	159.2000	75.2000
	N	50	50	50	50
	Std. Deviation	37.91774	16.66471	62.00197	32.02295
2.00	Mean	108.4200	74.9800	185.6000	87.2000
	N	50	50	50	50
	Std. Deviation	32.24276	30.59311	55.62851	24.49823
3.00	Mean	96.2000	30.2000	104.8000	49.9400
	N	50	50	50	50
	Std. Deviation	25.78482	8.44913	18.87013	12.62070
Total	Mean	106.5400	53.0467	149.8667	70.7800
	N	150	150	150	150
	Std. Deviation	33.08209	27.55844	59.48308	28.80550

The results by pair of T-test analysis are shown between three male age classes (young, middle and old age) there was a significant relation, *p value*< 0.00 compared between three age classes (young, middle and old) and are given in Table 2. The difference in the number of eggs between three age classes is significantly reduced at female flies when mated with old aged, the among of egg laid is lower than middle and young aged male, Old<middle<young. The results of t-test analysis between pairs elements including, age and temperature, temperature and female fecundity, temperature and female fertility, temperature and female when mated with sons, (fecundity and fertility) and also between age and female fecundity and fertility and son fitness traits were significant, *p value*< 0.00.

Table 2: The results of female fecundity, female fertility and male age reproductive performance and also son fitness traits were compared with T-Test analysis, the results are shown there was a significant variation, p value<0.00, between parameters of parental and offspring of *Drosophila melanogaster*.

Paired Samples Test				
		t	df	Sig. (2-tailed)
Pair 1	Ages – fecundity	-38.469	149	.000
Pair 2	Ages - fertility	-22.442	149	.000
Pair 3	Ages – son fecundity	-30.287	149	.000
Pair 4	Ages – son fertility	-28.938	149	.000
Pair 5	Temperature - fecundity	-38.469	149	.000
Pair 6	Temperature - fertility	-22.442	149	.000
Pair 7	Temperature – son fecundity	-30.287	149	.000
Pair 8	Temperature – son fertility	-28.938	149	.000

Also the results were compared in figure 1, the length of graph in female egg laid when mated with male young aged is longer than middle and old aged male, however the age of females were similar in three aged males.

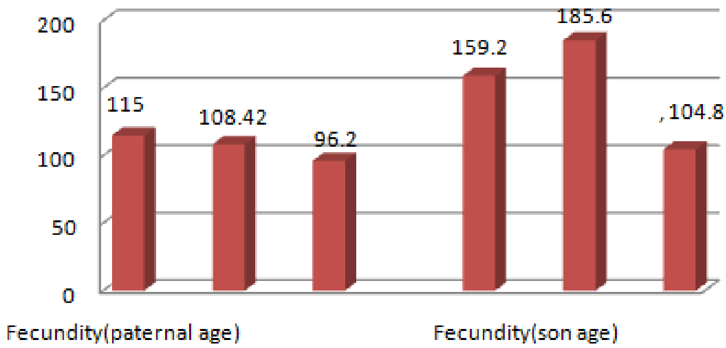

Fig.1: Fecundity parameter was analysed by SPSS software, the results of mean value are shown, from left to right, are three graphs that includes, young, middle and old aged respectively, for paternal fecundity and also three graphs from left to right including, young, middle and old aged respectively for female fecundity that mated with sons. Values are given as means ±SE (N= 50). The length of graphs indicates the variation activity in different ages (Young, Middle and Old).

Also the among of egg laid when females mated with son flies, the length of graph in 27-28 days aged old longer than 2-3 days aged old and 52-53 days aged old (Figure 2). The son fitness traits also were analysed, son flies obtained from three age classes, young male age (2-3 days ages), middle male age (27-28 days) and old male age (52-53 days) mated with female 5-6 days aged old, all of son were 7 days aged old and were recorded. In diagram 1 are shown.

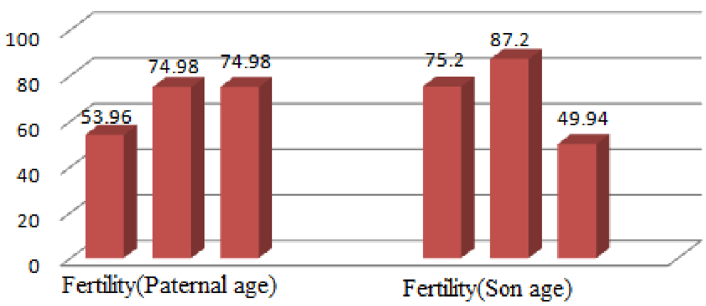

Fig. 2: Fertility parameter was analysed by SPSS software, the results of mean value are shown, from left to right, are three graphs that includes, young, middle and old aged respectively, for paternal fertility and also three graphs from left to right including, young, middle and old aged respectively for female fertility that mated with sons. Values are given as means ±SE (N= 50).

2-3 days aged male) × 5-6 (female) → Son (7 days aged old ×5-6 days female = offspring)
↓
27-28 days aged male) ×5-6 (female) → Son (7 days aged old ×5-6 days female= offspring)
↓
52-53 days aged male) × 5-6 (female) → Son (7 days aged old ×5-6 female = offspring)

Diagram 1: The pattern of mating, between parental and offspring flies. The parental including, male 2-3 days aged old (young), male 27-28 days aged old (middle) and male 52-53 days aged old (old) that mated with female 5-6 days aged old, the off spring from these parental mated with female 5-6 days aged old and was recorded.

DISCUSSION

Drosophila melanogaster will be adapted at divergent temperature. (Partridge *et al.,*1995). When tested, flies of both sexes had greater lifespan, and females showed higher fecundity and fertility when exposed to normal temperature (18- 25°c) than flies adapted to an alternative temperature. We have shown that male reproductive performance also evolved in response to exposure of thermal environment (Calboli, *et al.,* 2003; Feder *et al.,* 1996; Kamping & Van Delden, 1999; Mckenzie, 1975; Parsons, 1978). There is relationship between temperature and aging in male and female, our results are in accordance with previous studies that have shown a positive effect of mate choice on components of fitness in *Drosophila melanogaster* (Partridge, 1980; Promislow *et al.,* 1998). We are shown that paternal age effect influenced female fecundity and fertility that females were mated with male young aged, the among of fecundity and fertility is higher than male middle and old aged. Also, in offspring fitness, we found paternal effect influenced offspring fitness traits. In general, maternal age effects appeared to have a greater influence on daughters than sons, whereas, paternal age effects seemed to have a larger influence on sons than daughters (Butz and Hayden 1961). The results are shown; the male middle aged influenced the son fitness traits more than young and old aged. Females of these males the among of egg laid and egg hatchability was high, therefore, this study showed that age effect on the reproductive performance , the same study had done by Jones *et al*., 2000, that females of *sandflies* prefer middle than male young and older aged, in accordance with these studies performed by Chapman *et al*., 1995 and Wolfner 1997, they suggested that paternal age effects may influence quality directly, through factors in the sperm pronucleus, or indirectly, male influence of female in during of mating, there are accessory gland proteins (ACPs) in males can influence on female physiological reproductive performance. The among of secretion accessory gland is related to aging in *Drosophila* species (Ravi Ram and Ramesh, 2007). Also, Chen, 1984 proposed the among of egg laid in female will be stimulated by proteins transferred from males that produced from accessory gland. Therefore male middle aged has more secreted accessory gland protein than young and old aged. Finally, we suggested that age influenced mating activities; the effect of aging can be positive or negative. The male young aged however affected female fecundity and fertility, but also female preferred middle male because middle male is higher genetic quality. Therefore the results of our simulations suggest that female preference for young and old aged mate is more likely to evolve than a strong preference for middle mates, and that female preference based on male age will not evolve if there is a cost associated with the preference. Therefore, females preferred middle aged because middle age accumulated good genes models for sexual selection.

ACKNOWLEDGMENTS

This work had financially supported by the Research Council of Islamic Azad University Tonekabon Branch, Iran.

REFERENCES

Anderson, W.W. (1973). Genetic divergence in body size among experimental populations of *Drosophila pseudoobscura* kept at different temperatures. Evolution, 27: 278–284.

Butz, A. and Hayden, P. (1961). Effects of age of male and female parents on the life cycle of *Drosophila melaongaster*. Ann. Entomol. Soc. Am. 55,617-618.

Brittnacher, J. G. (1981). Genetic variation and genetic load due to the male reproductive component of fitness in *Drosophila*. Genetics, 97:719-730.

Brooks, R. and Kemp, D.J. (2001. Can older males deliver the good genes? Trends in Ecology and Evolution, 16: 308-313.

Chapman, T.; Liddle, L. F.; Kalb, J. M.; Wolfner, M. F. and Partridge, L. (1995). Cost of mating in *Drosophila melanogaster* is mediated by accessory gland products. Nature, 373:241-244.

Chen, P. S. (1984). The functional morphology and biochemistry of insect male accessory glands and their secretions. Ann. Rev. Entomol, 29:233- 255.

David, J.R.; Allemand, R.; Van Herrewege, J. and Cohet, Y. (1983). Ecophysiologie: abiotic factors. In: M. Ashburner, H.L. Carson and J.N. Thompson, (Eds.) Genetics and biology of *Drosophila* (pp. 105-170) Academic Press, New York..

Fasolo, A.G. and Krebs, R.A. (2004). A comparison of behavioral change in *Drosophila* during exposure to thermal stress, Biological Journal of the Linnean Society, 83: 197-205.

Federico, C. F. Calboli.; George W. Gilchrist and Partridge, L. (2003). Different cell size and cell number contribution in two newly established and one ancient body size cline of *Drosophila Subobscura*. Evolution, 57(3): 2003.

Feder, M.E. and Krebs, R.A. (1997). Ecological and evolutionary physiology of heat-shock proteins and the stress response in *Drosophila*: complementary insights from genetic engineering and natural variation. In Bijlsma, R., V. Loeschcke. (Eds.), Stress, Adaptation, and Evolution (pp. 155-173).

Fulker, D.W. (1966). Mating speed in male *Drosophila melanogaster:* A psychogenetic analysis. Science, 153: 203-205.

Hansen T.F. and Price, D.K. (1995). Good genes and old age: Do old mates provide superior genes? Journal of Evolutionary Biology, 8: 759-778.

Jones, T.M.; Balmford, A. and Quinnell, R.J. (2000). Adaptive female choice for middle-aged mates in a lekking *sandfly*. Proc. R. Soc. Lond, 267: 681-686.

Kamping, A. and Vandelden, W. (1999). A long-term study on interactions between the Adh and aGpdh allozyme polymorphisms and the chromosomal inversion In (2L)t in a seminatural population of *D. melanogaster*. J. Evol. Biol. 12: 809-821.

Lubkinbill, L.; Arking, R.; Clare, M.J.; Cirocco, W.C. and Buck, S. (1984). Selection of delayed senescence in *Drosophila melanogaster*. Evolution, 38: 996-1003.

Mckenzie, J. A. (1975). The influence of low temperature on survival and reproduction in populations of *Drosophila melanogaster*. Aust. J. Zoological, 23: 237-247.

Parsons, P. A. (1978). The effect of genotype and temperature on longevity in natural populations of *Drosophila melanogaster.* Experimental Gerontology, 13: 167-169.

Parsons, P. A. (1973). Genetic of resistance to environmental stresses in *Drosophila* populations. Annu. Rev. Genet. 7: 239-265.

Partridge, L. and K. Fowler. (1992). "Direct and correlated responses to selection on age at reproduction in *Drosophila melanogaster*." Evolution, 46: 76-91.

Partridge, L. (1980). Mate choice increases a component of offspring fitness in fruit flies. Nature, 283: 290-291.

Partridge, L.; Barrie, B.; Barton, N.H.; Fowler, K. and French, V. (1995). Rapid laboratory evolution of adult life history traits in *Drosophila melanogaster* in response to temperature. Evolution, 49: 538–544.

Partridge, L. and Barton, N.H. (1996). On measuring the rate of ageing. Proceedings of the Royal Society of London: Series, 263 (B): 1365–1371.

Promislow, D.L.; Smith, E.A. and Pearse, L. (1998). Adult fitness consequences of sexual selection in *Drosophila melanogaster*. Proc. Natl. Acad. Sci. USA, 95: 10687–10692.

Prout, T. (1971). The relation between fitness components and population prediction in *Drosophila*. I. The estimation of fitness components. Genetics, 68: 127–149.

Rose, M. R. (1984). Laboratory evolution of postponed senescence in *Drosophilu melunoguster.* Evolution, 38: 1004- 1010.

Ravi Ram, K. and Ramesh, S.R. (2007). Male accessory gland secretary protein polymorphism in natural populations of *Drosophila nasuta nasuta* and *Drosophila sulfurigaster neonasuta.* Journal genetics, 86: 217–224.

Serradilla, J. M. and Ayala, F. J. (1983). Al- loprocoptic selection: A model of natural selection promoting polymorphism. Proc. Nat. Acad. Sci. USA, 80:2022-2025.

Wolfner, M. F. (1997). Tokens on love: functions and regulation of *Drosophila* male accessory gland products. Insect Biochem. Molec. Biol. 27:179-192.

Zwaan, B.; Bijlsma, R. and Hoekstra, R. E. (1995). Direct selection on life span in *Drosophila melanogaster*. Evolution, 49:649-659.